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# 78ST200 Series

**2 AMP POSITIVE STEP-DOWN  
INTEGRATED SWITCHING REGULATOR**

**Revised 6/30/98**

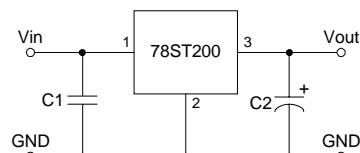


- High Efficiency > 82%
- Wide Input Range
- Self-Contained Inductor
- Short-Circuit Protection
- Over-Temperature Protection
- Fast Transient Response

The 78ST200 is a series of wide input voltage, 3 terminal Integrated Switching Regulators (ISRs). Employing a ceramic substrate, these ISRs have a maximum output current of 2A. The output voltage is laser trimmed for high accuracy.

The 78ST200 series regulators have internal short-circuit and over-temperature protection and may be used in a wide variety of applications.

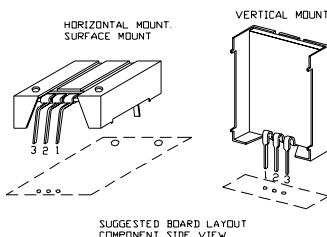
## Standard Application



C1 = Optional 1 $\mu$ F ceramic  
C2 = Required 100 $\mu$ F electrolytic

## Pin-Out Information

Pin No.	Function
1	V <sub>in</sub>
2	GND
3	V <sub>out</sub>



## Ordering Information

**78ST2 XX Y C**

Output Voltage

**33** = 3.3 Volts  
**35** = 3.45 Volts  
**05** = 5.0 Volts

Package Suffix

**V** = Vertical Mount  
**S** = Surface Mount  
**H** = Horizontal Mount

(For dimensions and PC board layout see Package Style 500.)

## Specifications

Characteristics (T <sub>a</sub> = 25°C unless noted)	Symbols	Conditions	78ST200 SERIES			Units
			Min	Typ	Max	
Output Current	I <sub>o</sub>	Over V <sub>in</sub> range	0.1*	—	2.0	A
Input Voltage Range	V <sub>in</sub>	I <sub>o</sub> = 0.1 to 3.0A V <sub>o</sub> < 3.5V V <sub>o</sub> = 5.0V	7 8	—	15 20	V V
Output Voltage Tolerance	$\Delta V_o$	Over V <sub>in</sub> range, I <sub>o</sub> = 2.0A T <sub>a</sub> = 0°C to +60°C	—	±1.0	±2.0	%V <sub>o</sub>
Line Regulation	Reg <sub>line</sub>	Over V <sub>in</sub> range	—	±0.4	±0.8	%V <sub>o</sub>
Load Regulation	Reg <sub>load</sub>	0.1 ≤ I <sub>o</sub> ≤ 2.0A	—	±0.2	±0.4	%V <sub>o</sub>
Ripple/Noise	V <sub>n</sub>	V <sub>in</sub> = V <sub>in</sub> min, I <sub>o</sub> = 2.0A	—	1	—	%V <sub>o</sub>
Transient Response (with 100 $\mu$ F output cap)	t <sub>tr</sub>	50% load change V <sub>o</sub> over/undershoot	—	100 5.0	—	$\mu$ Sec %V <sub>o</sub>
Efficiency	$\eta$	V <sub>in</sub> = 9V, I <sub>o</sub> = 2.0A, V <sub>o</sub> = 5V	—	82	—	%
Switching Frequency	f <sub>o</sub>	Over V <sub>in</sub> and I <sub>o</sub> ranges	0.95	1.0	1.05	MHz
Absolute Maximum Operating Temperature Range	T <sub>a</sub>	—	-40	—	+85	°C
Recommended Operating Temperature Range	T <sub>a</sub>	Free Air Convection, (40-60LFM) Over V <sub>in</sub> and I <sub>o</sub> ranges	-40	—	+85**	°C
Thermal Resistance	$\theta_{ja}$	Free Air Convection, (40-60LFM)	—	38	—	°C/W
Storage Temperature	T <sub>s</sub>	—	-40	—	+125	°C
Mechanical Shock	—	Per Mil-STD-883D, Method 2002.3	—	500	—	G's
Mechanical Vibration	—	Per Mil-STD-883D, Method 2007.2, 20-2000 Hz, soldered in a PC board	—	5	—	G's
Weight	—	—	—	7	—	Grams

\* ISR will operate down to no load with reduced specifications.

\*\* See Thermal Derating chart.

**Note:** The 78ST200 Series requires a 100 $\mu$ F electrolytic or tantalum output capacitor for proper operation in all applications.

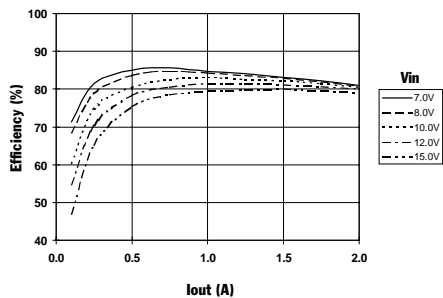
# 78ST200 Series

## CHARACTERISTIC DATA

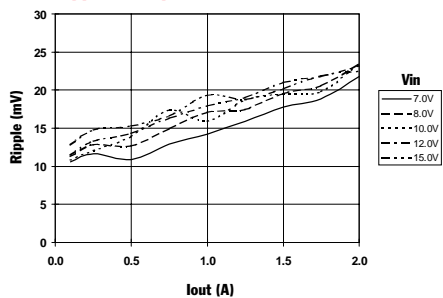
### 78ST233 3.3 VDC

(See Note 1)

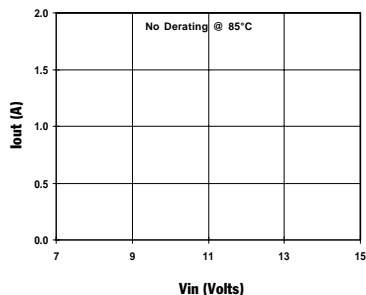
#### Efficiency vs Output Current



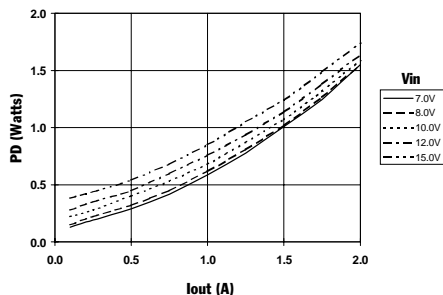
#### Ripple vs Output Current



#### Thermal Derating ( $T_a$ ) (See Note 2)



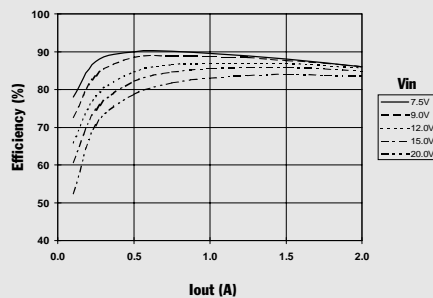
#### Power Dissipation vs Output Current



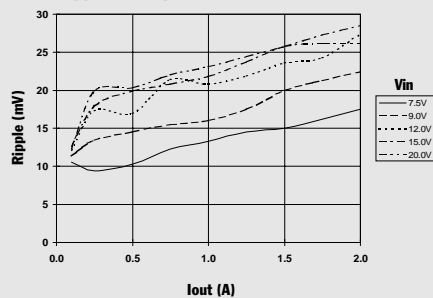
### 78ST205 5.0 VDC

(See Note 1)

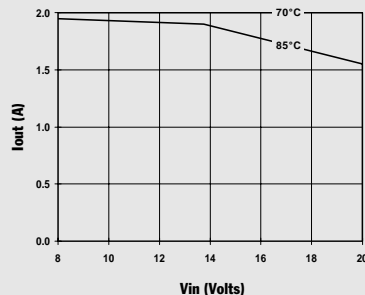
#### Efficiency vs Output Current



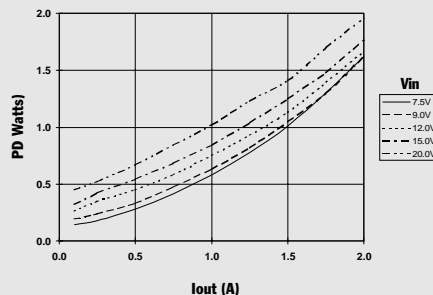
#### Ripple vs Output Current



#### Thermal Derating ( $T_a$ ) (See Note 2)



#### Power Dissipation vs Output Current



**Note 1:** All data listed in the above graphs, except for derating data, has been developed from actual products tested at 25°C. This data is considered typical data for the ISR.

**Note 2:** Thermal derating graphs are developed in free air convection cooling of 40-60 LFM. (See Thermal Application Note)



## PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
78ST205SCT	OBSOLETE	SIP MODULE	EFC	3		TBD	Call TI	Call TI	-40 to 85		
78ST235HC	NRND	SIP MODULE	EFA	3		TBD	Call TI	Call TI	-40 to 85		
78ST235SC	OBSOLETE	SIP MODULE	EFC	3		TBD	Call TI	Call TI	-40 to 85		
78ST235VC	OBSOLETE	SIP MODULE	EFD	3		TBD	Call TI	Call TI	-40 to 85		

(1) The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "-" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

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Datasheet of 78ST233VC - REGULATOR 3.3V 2A 3PSIP VRT

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2-Feb-2014

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